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February 11, 2000

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09/14 85443  
416 Rec'd PCT/PTO 11 FEB 2000

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**ATTN: BOX PCT**

Re: Application of Wei CHEN and Yun-Gik LEE/  
METHOD OF OPTIMIZING THE TOPOLOGY OF THE IEEE 1394 SERIAL BUS/  
Our Reference: Q57774  
PCT/KR99/00291, filed June 12, 1999 ✓

Dear Sir:

Applicants herewith submit the attached papers for the purpose of entering the National stage under 35 U.S.C. § 371 and in accordance with Chapter I of the Patent Cooperation Treaty. Attached hereto is the application identified above which is a translation of PCT International Application No. PCT/KR99/00291, filed June 12, 1999, comprising the specification, claims and thirteen (13) sheets of drawings. The executed Declaration and Power of Attorney and Assignment will be submitted at a later date.

The Government filing fee is calculated as follows:

Total Claims	5 - 20 =	0 x \$18 =	\$ 000.00
Independent Claims	2 - 3 =	0 x \$78 =	\$ 000.00
Base Filing Fee	(\$970.00)		\$ 970.00
Multiple Dep. Claim Fee	(\$260.00)		\$ 000.00
<b>TOTAL FILING FEE</b>			<b>\$ 970.00</b>

A check for the statutory filing fee of \$ 970.00 is attached. You are also directed and authorized to charge or credit any difference or overpayment to Deposit Account No. 19-4880. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. 1.492; 1.16 and 1.17 and any petitions for extension of time under 37 C.F.R. 1.136 which may be required during the entire pendency of the application to Deposit Account No. 19-4880. A duplicate copy of this transmittal letter is attached.

Priority is claimed from:

**Korean Patent Application**

21903/1998

**Filing Date**

June 12, 1998

Respectfully submitted,  
SUGHRUE, MION, ZINN, MACPEAK & SEAS  
Attorneys for Applicant(s)

By: 

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Reg. No. 23,063

DM:clf

METHOD OF OPTIMIZING THE TOPOLOGY OF THE IEEE 1394SERIAL BUS

## BACKGROUND OF THE INVENTION

5 1. Field of the Invention

The present invention relates to the IEEE 1394 network, and more particularly a method of optimizing the topology of the IEEE 1394 serial bus.

2. Description of the Related Art

10 The IEEE 1394 is a multimedia interface of the next generation for enabling information exchange among various multimedia instruments according to the specification prepared by IEEE (Institute of Electrical and Electronics Engineers), which provides a serial bus standard to enable communication of audio and video data among multimedia instruments such as HD-TV, DVD and DVC, differing from the conventional interface only to allow the connection between the personal  
15 computer and the peripheral devices such as mouse, printer, scanner, etc. The IEEE 1394 technology has been rapidly developed by engineers practicing electronics, communications and computer, presently providing for a high data transmission speed of 400Mbps, plug & play system, 63 nodes on a single bus, etc.

In order to optimize the topology of the IEEE 1394 serial bus may be used  
20 the following three methods. First, the cable topology is reconstructed so as to

reduce the hop number. Second, the cable topology is reconstructed so as to arrange the nodes of the same speed capacity adjacent to each other. Third, the gap count is optimized for the present cable topology. However, the IEEE 1394 specification only defines the third method to reduce the gap count according to the maximum  
5 hop number of the present cable topology.

In the IEEE 1394 cable environment, the nodes are connected in the form of daisy-chain, as shown in Fig. 3 illustrating the structure of the IEEE 1394 serial bus network using three ports. In the drawing, reference numerals 10, 30 and 40 represent nodes, and 20 hop. There are shown 36 nodes existing in a single bus,  
10 where the maximum hop number between two nodes, for example, the node numbered 1 and the node numbered 17, becomes 16. In such IEEE 1394 serial bus network as shown in Fig. 1, if there occurs a transmission speed difference between the adjacent nodes, the efficiency of the high speed node (for example, 200Mbps) may be reduced by the low speed node (for example, 100Mbps). Hence, in the IEEE  
15 1394 cable environment, it is necessary to connect together all the nodes existing in a single bus and construct the topology for keeping the speed capacity of each node as great as possible.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method of optimizing the  
20 topology of the IEEE 1394 serial bus, which may connect all the nodes existing in a single bus to keep the speed capacity of each node as great as possible in a network constructed by employing the IEEE 1394 serial bus.

According to an aspect of the present invention, a method of optimizing the topology of the IEEE 1394 serial bus having a plurality of nodes each with  
25 communication ports, comprises the steps of prioritizing the nodes according to the

number of the ports and the transmission speed, connecting a non-used port of the node of the first priority with a port of the node of the second priority, and repeating the previous step until all of the nodes are connected together, whereby the nodes are connected through the ports according to priority order.

5       The present invention will now be described more specifically with reference to the drawings attached only by way of example.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

Fig. 1 is a schematic diagram for illustrating the structure of the network of the IEEE 1394 serial bus employing three ports;

10       Fig. 2 is a flow chart for illustrating the procedure of optimizing the topology of the serial bus according to the present invention;

Figs. 3A to 3E illustrate an example of connecting the nodes according to the flow chart of Fig. 2; and

15       Figs. 4A to 4F illustrate another example of connecting the nodes according to the flow chart of Fig. 2.

### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

Describing the procedure of optimizing the topology of the IEEE 1394 serial bus in connection with Fig. 3A, there are shown six nodes respectively providing  
20   the transmission speeds (hereinafter referred to as "speed") of 100Mbps, 200Mbps and 400Mbps. Reference numerals 0, 1, 2 represent the port numbers of each node. Firstly, referring to Fig. 2, the bus controller detecting the number of the ports and

speed of each node in step 100. Then, the bus controller determines in step 110 whether the total port number is equal to or greater than  $2(N-1)$ , where "N" represents the number of all the nodes. This is to confirm that all the nodes may be connected with the serial bus. In the present embodiment, the number N of the  
5 nodes is 6, and the total port number 11, so that the prerequisite of the step 110 is satisfied. In step 130, the nodes are prioritized according to the speed and the number of ports. In this case, the speed is firstly considered, and then the number of ports. As shown in Fig. 3B, the order of priority becomes lower in the direction of the arrow from "A" to "B".

10 In step 140, a non-used port of the node of the first (higher) priority is connected with a port of the node of the second (lower) priority. Then, the bus controller sequentially repeats the steps 150, 160 and 140. Thus, the node of 400Mbps having three ports makes the first connection (①) with a node of 200Mbps having a single port as shown in Fig. 3C, and the second connection with  
15 another node of 200Mbps having a single port as shown in Fig. 3D. Consequently, all the nodes are connected together as represented by the connections ①, ②, ③, ④, ⑤ in Fig. 3E. When it is confirmed in step 150 that all the nodes are completely connected, Fig. 3E shows the optimized topology map, where the maximum hop number  $HOP_{max}$  between two nodes has the minimum value ( $HOP_{max}$   
20 =3), and the speed capacity of each node is secured.

Describing another embodiment of optimizing the topology of the serial bus having six nodes as shown in Fig. 4A, the bus controller determines in step 110 whether the total port number is equal to or greater than  $2(N-1)$ . If the total port number is smaller than  $2(N-1)$  indicating that the normal connection of the nodes  
25 is impossible, the nodes are adjusted in step 120. In the present embodiment, the node number "N" is 6, and the total port number 11, so that the prerequisite of the

step 110 is satisfied. Then, the bus controller goes to step 130 to prioritize the nodes according to the speed and number of the ports, as shown in Fig. 4B. Likewise, the order of priority becomes lower in the direction of arrow from "A" to "B".

In step 140, a non-used port of the node of the first (higher) priority is  
5 connected with a port of the node of the second (lower) priority. Thus, the node of 400Mbps having three ports makes the first connection (①) with the node of 400Mbps having a single port as shown in Fig. 4C. The bus controller sequentially repeats the steps 150, 160 and 140 to connect all the nodes. However, the nodes arranged as shown in Fig. 4A may not be normally connected through the steps 140  
10 to 160. Namely, the fourth connection between a node of 200Mbps and a node of 100Mbps is impossible since each of 200Mbps nodes has a single port. More specifically describing in connection with Fig. 4D, the 200Mbps node may not be connected with the 100Mbps after making the first, second and third connections ①, ②, ③ between the nodes of 400Mbps and 200Mbps.

15 Hence, if the bus controller detects in step 160 that all ports of the node of higher priority are used, it goes to step 170 to separate the last connected node, and then to move the node of foremost priority among the next speed group before the separated node. Accordingly, the priority arrangement of the nodes as shown in Fig. 4B is rearranged as shown in Fig. 4E. Based on the new priority arrangement, the  
20 bus controller repeats the steps 140 to 160 to achieve the final connections ①, ②, ③, ④, ⑤ as shown in Fig. 4F. Then, the bus controller goes to step 180 to determine whether the maximum hop number  $HOP_{max}$  exceeds 16. If so, the priority order is readjusted in step 190, returning to step 140. In the present embodiment, the maximum hop number  $HOP_{max}$  between two arbitrary nodes is 3, satisfying the  
25 requirement of the step 180. Hence, in the optimized topology map as shown in Fig. 4E, the maximum hop number  $HOP_{max}$  between two nodes has the minimum value

( $HOP_{max}=3$ ), and the speed capacity of each node is secured.

While the present invention has been described with specific embodiments accompanied by the attached drawings, it will be appreciated by those skilled in the art that various changes and modifications may be made thereto without departing the gist of the present invention.

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**WHAT IS CLAIMED IS:**

1. A method of optimizing the topology of the IEEE 1394 serial bus having a plurality of nodes each with communication ports, comprising the steps of:

prioritizing said nodes according to the number of said ports and the  
5 transmission speed;

connecting a non-used port of the node of the first priority with a port of the node of the second priority; and

repeating the previous step until all of said nodes are connected together, whereby said nodes are connected through said ports according to priority order.

10 2. A method as defined in Claim 1, wherein the step of prioritizing is performed so as to firstly assign higher priority to the node of greater transmission speed, and then to secondly assign higher priority to the node having greater number of said ports.

3. A method of optimizing the topology of the IEEE 1394 serial bus  
15 having a plurality of nodes each with communication ports, comprising the steps of:

comparing the total port number of all of said nodes with a reference value varying with the number (N) of said nodes to determine whether the prerequisite for constructing said topology is satisfied;

prioritizing said nodes according to the number of said ports and the  
20 transmission speed when said prerequisite is satisfied;



connecting a non-used port of the node of the first priority with a port of the node of the second priority;

repeating the previous step until all of said nodes are connected together; and

separating the last connected node to assign to the node of the foremost  
5 priority among the next speed group higher priority than the separated node when  
no port remains in the node of the first priority to connect with the node of the  
second priority during the previous step, whereby said nodes are connected through  
said ports according to priority order.

4. A method as defined in Claim 3, wherein the step of comparing  
10 determines that the prerequisite for constructing said topology is satisfied if the total  
port number of all of said nodes is equal to or greater than  $2(N-1)$ .

5. A method as defined in Claim 3, wherein the step of prioritizing is  
performed so as to firstly assign higher priority to the node of greater transmission  
speed, and then to secondly assign higher priority to the node having greater number  
15 of said ports.

### ABSTRACT OF THE DISCLOSURE

A method of optimizing the topology of the IEEE 1394 serial bus having a plurality of nodes each with communication ports, comprises the steps of prioritizing the nodes according to the number of the ports and the transmission speed, connecting  
5 a non-used port of the node of the first priority with a port of the node of the second priority, and repeating the previous step until all of the nodes are connected together, whereby the nodes are connected through the ports according to priority order.

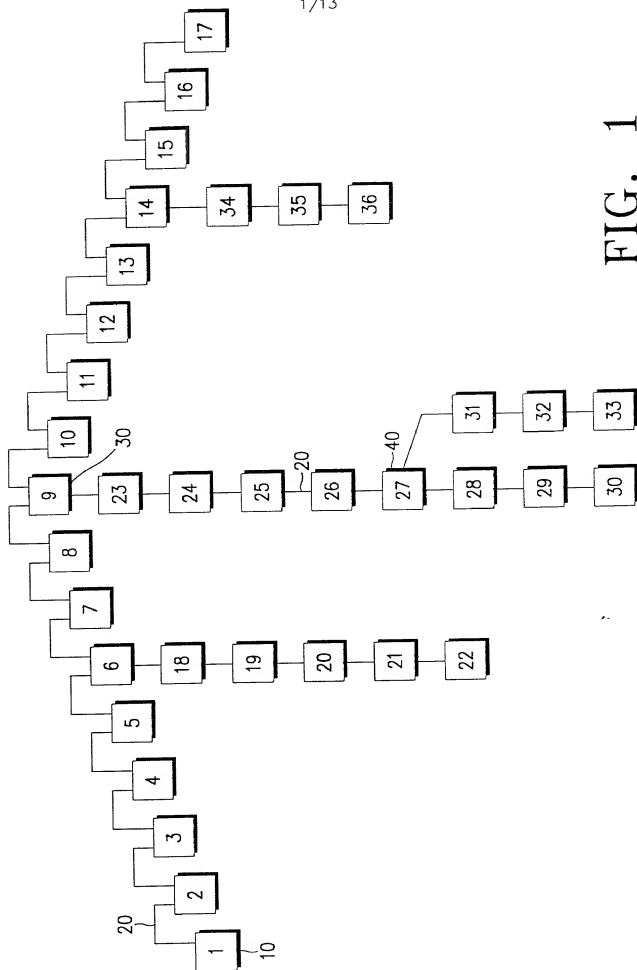


FIG. 1

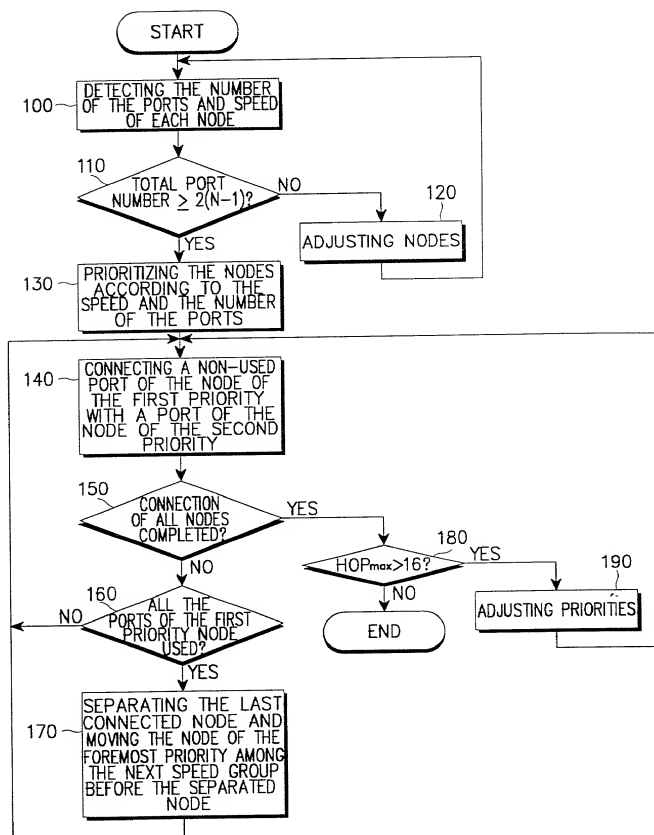


FIG. 2

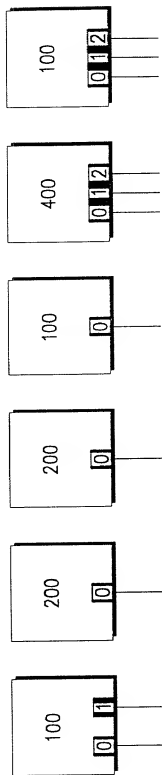


FIG. 3A

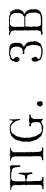


FIG. 3B

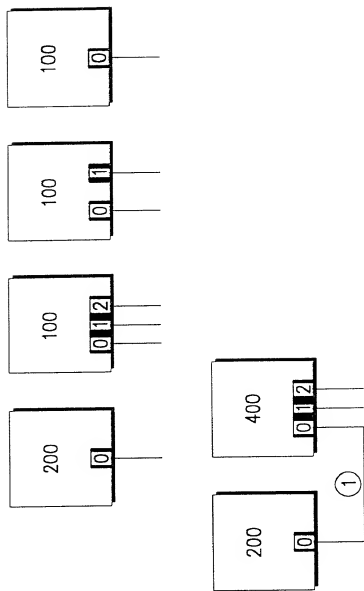


FIG. 3C

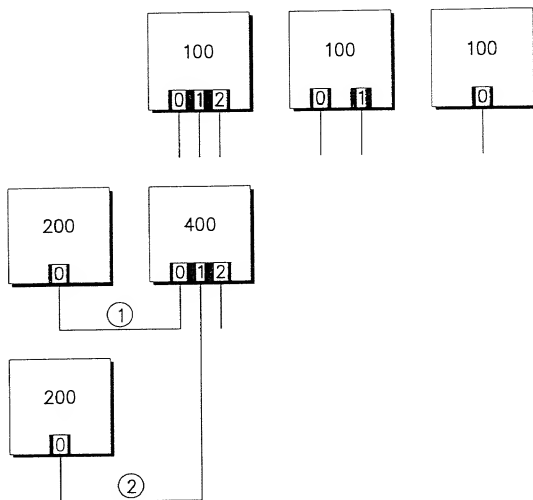


FIG. 3D



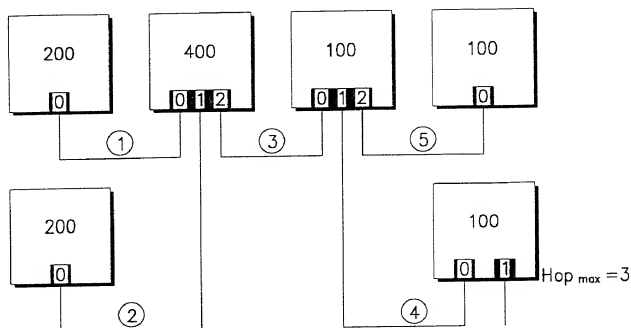


FIG. 3E

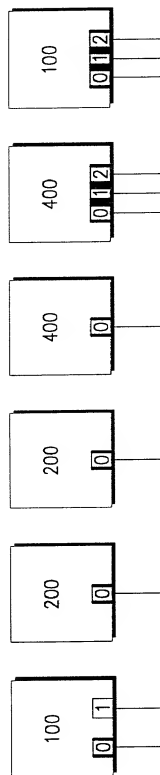


FIG. 4A

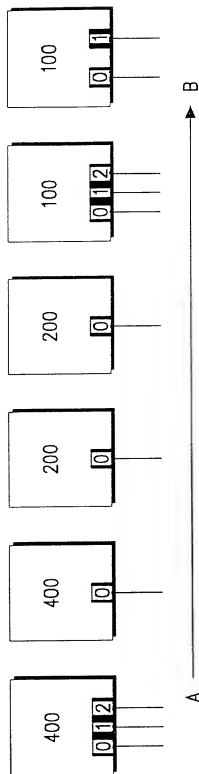


FIG. 4B

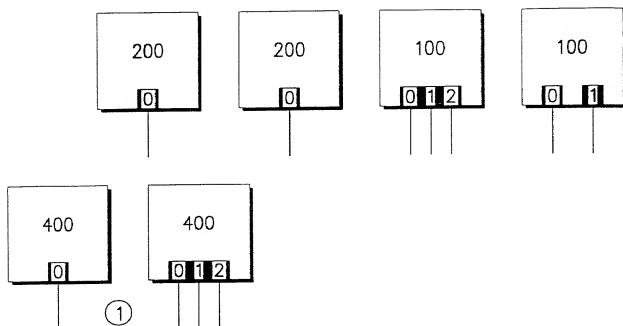


FIG. 4C

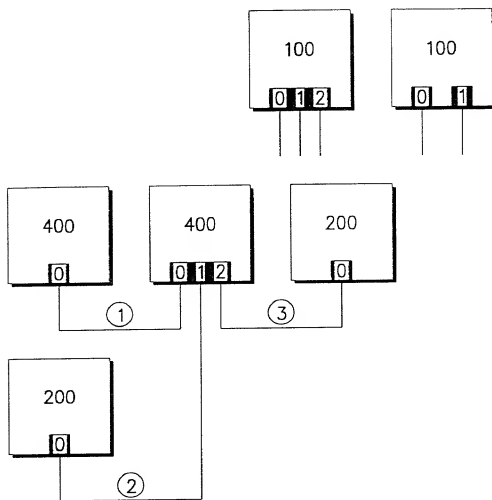
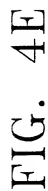


FIG. 4D



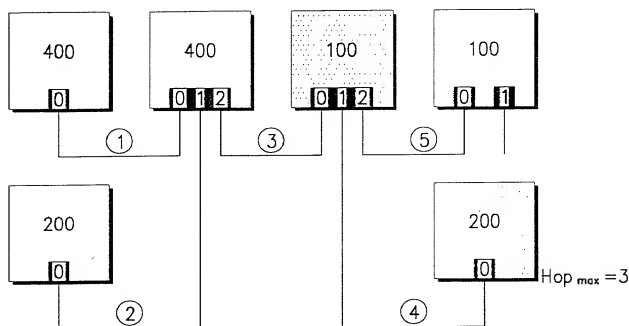


FIG. 4F

# Declaration and Power of Attorney For Patent Application

출원서원본상의 선서서와 위임장

Korean Language Declaration

한국어 선서서

하기한 발명자인 본인은 다음과 같이 선서합니다:

본인의 주소, 우편주소 및 국적은 본인의 이듬 밑에 기재된 바와 같습니다.

본인은 아래에 기재된 발명에 대한 최초의 단독발명자 (단 한사람의 이름이 아래에 기재되었을 경우) 또는 공동발명자 (복수의 발명자가 아래에 기재되었을 경우) 라고 믿습니다.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

METHOD OF OPTIMIZING THE TOPOLOGY

OF THE IEEE 1394 SERIAL BUS

아래 박스에 표시가 되어있지 않는 한  
특허심판서는 여기에 첨부되어 있음:

☐ \_\_\_\_월 \_\_\_\_일 미국출원번호 또는 PCT국제출원번호  
\_\_\_\_로 출원되었으며  
\_\_\_\_월 \_\_\_\_일 수정되었습니다.  
(만약 적용가능하면)

the specification of which is attached hereto unless the following box is checked:

☒ was filed on February 11, 2000  
as United States Application Number or  
PCT International Application Number  
\_\_\_\_ and was amended on  
\_\_\_\_ (if Applicable).

본인은 상기 수정출원을 포함하여 특허심판서 내용을 검토하였으며 잘 파악하고 있음을 선서합니다.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

본인은 연방규정법전 37장 1.56편에 따라 특허자격에 있어 중요한 정보자료를 밝히는 것이 본인의 의무임을 인정합니다.

I acknowledge the duty to disclose information which is material to patentability as defined in the Title 37, Code of Federal Regulations, Section 1.56.



# Korean Language Declaration

## 한국어 선언서

본인은 미합중국법전 35장 119(a)-(d)편 또는 특허 또는 발명자 증서를 위한 그 어떤 외국출원의 365(b)편 또는 미국 이외에 최소한 한 국가를 지칭하는 PCT국제출원의 365(a)편하의 외국우선권을 주장합니다. 아래 박스에 표시함으로써 기재하고 확인합니다.

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Priority Not Claimed  
우선권 주장 안함

이전의 외국 출원

P1998-21903 ✓ KOREA  
Number) (번호) (Country) (국명)

12/06/1998  
(Day/Month/Year Filed) (출원년월일)

☐

Number) (번호) (Country) (국명)

(Day/Month/Year Filed) (출원년월일)

☐

Number) (번호) (Country) (국명)

(Day/Month/Year Filed) (출원년월일)

☐

본인은 미합중국법전 35장, 아래에 기재한 그 어떤 미국 가출원의 119(e)편하의 권한을 주장합니다.

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.) (출원번호) (Filing Date) (출원일)

(Application No.) (출원번호) (Filing Date) (출원일)

본인은 미합중국법전 35장, 그 어떤 미국출원의 120 편 또는 미국을 지칭하는 그 어떤 PCT국제출원의 365(c)편하의 권한을 주장합니다. 미합중국법전 35장 112편의 첫단락에 제시된 방법에 따라 이전의 미국 또는 PCT국제출원에 이제까지 기재된 본출원 내용은 밝혀지지 않았습니다. 본인은 연방규정법전 37장 1.56편에 따라 이전출원의 출원일과 국내 또는 PCT국제출원의 출원일사이의 유효한 특허자격에 있어 중요한 정보자료를 밝히는 것이 본인의 의무임을 인정합니다.

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Application No.) (출원번호) (Filing Date) (출원일)

(Status: Patented, Pending, Abandoned) (현황: 특허완료, 심사중, 포기됨)

(Application No.) (출원번호) (Filing Date) (출원일)

(Status: Patented, Pending, Abandoned) (현황: 특허완료, 심사중, 포기됨)

본인이 아는 바에 의하면 여기에 작성된 모든 기재사항들과 정보자료로 제출한 모든 기재사항들은 진실된 것임 을 선언하며, 그리고 이러한 진술이 고의적인 허위진술 이거나 이와 비슷한 경우에는 미합중국법전 18장 1001 편에 따라 벌금이나 징역형 또는 그 병과형으로 처벌되 며, 허위진술은 본출원의 유효성이나 발명된 특허증을 위태롭게 할 수도 있다는 점을 선언합니다.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

## Korean Language Declaration

## 한국어 섹서서

위임장: 본인은 본건출원과 관련된 모든 사무를 처리하기 위하여 대리인을 지명합니다. 상기 각자는 대리인과 위수 및 업무재료가 적어있는 대리인을 지명할 전권을 갖습니다. (성명 및 등록번호 기재)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number)

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